# **BME2102: INTRODUCTION TO BIOMECHANICS**

Effective Term

Semester B 2024/25

# Part I Course Overview

**Course Title** Introduction to Biomechanics

Subject Code BME - Biomedical Engineering Course Number 2102

Academic Unit Biomedical Engineering (BME)

**College/School** College of Biomedicine (BD)

**Course Duration** One Semester

Credit Units

Level B1, B2, B3, B4 - Bachelor's Degree

**Medium of Instruction** English

**Medium of Assessment** English

**Prerequisites** BCH1200/CHEM1200 Discovery in Biology or AP1201/PHY1201 General Physics I#

Precursors

Nil

Exclusive Courses Nil

Additional Information

# Prerequisites which are not part of the Major Requirement are waived for students admitted with Advanced Standing.

# Part II Course Details

Abstract

This course aims to introduce students to the fundamental concepts that are required for the development of biomedical prosthetic devices in the human body; to provide a supportive, directed experiential and cooperative learning environment for students to acquire and develop technique skills to solve diverse engineering problems in various biomedical products.

#### Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the fundamental concepts of biomechanics and their impacts on the behavior of physical bodies subject to forces or displacements.			x	
2	Identify the mechanical engineering problems in biomaterials and biomedical devices, explain the problems with critical thinking generated from mechanics concepts, and calculate the problems with mechanics theory.		X	X	
3	Apply the biomechanics knowledge to explain structural and functional behavior of biological systems such as humans, animals, plants, organs, cells.			X	X
4	Explain the procedure, results and analysis of the lab experiments in scientific written reports.			X	

### A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

### A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

### A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Students will develop a better understanding of biomechanics.	1, 2, 3	3 hrs/week
2	Tutorial/Laboratory Sessions	Students will engage in hands-on experiments in laboratory sessions. Students will discuss some biomechanics- related questions in tutorials.	1, 2, 3, 4	1.5 hrs/week for 2 weeks/3 hrs/week for 3 weeks

### Learning and Teaching Activities (LTAs)

## Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	In-class Test	1, 2, 3	20	
2	Laboratory Reports	4	20	3 reports to be submitted

#### Continuous Assessment (%)

40

#### Examination (%)

60

#### **Examination Duration (Hours)**

2

#### Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

#### Assessment Rubrics (AR)

#### Assessment Task

1. In-class Test

#### Criterion

Describe the mechanical design concepts and principles and provide solution to related design problems.

#### Excellent (A+, A, A-)

High

#### Good (B+, B, B-)

Significant

# Fair (C+, C, C-)

Moderate

# Marginal (D)

Basic

Failure (F) Not even reaching marginal levels

#### Assessment Task

2. Laboratory Reports

#### Criterion

Attendance of the lab/demo session; ABILITY to EXPLAIN the methodology and procedure and ANALYSE the lab data.

Excellent (A+, A, A-) High

# Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D) Basic

**Failure (F)** Not even reaching marginal levels

#### Assessment Task

3. Examination

#### Criterion

Explain the fundamental concepts and working principles, select proper machine elements and solve problems in the design process.

Excellent (A+, A, A-)

High

Good (B+, B, B-) Significant

Fair (C+, C, C-) Moderate

Marginal (D) Basic

**Failure (F)** Not even reaching marginal levels

# Part III Other Information

#### **Keyword Syllabus**

- Biomechanics, biomaterials, cells, tissues, organs, implants, human musculoskeletal system, biomedical devices, cell/ surface interactions, endovascular system, drug delivery, dental implants, hip/knee implants, doctor and patients, ethical issues
- Solid mechanics, fluid mechanics, physical bodies, vector, force, displacement, moment, mechanical properties, Hooke' s law, stress, strain, elasticity, plasticity, viscoelasticity, fracture, fatigue, wear, corrosion, toughening of materials, composites
- · Problem identification and solving techniques, lab planning and control, reporting and presentation

In addition to the examination and in-class test, students are required to learn through collaborative lab sessions in order to improve their understanding on strategic thinking, problem solving, team working processes, the relationships and interactions between the fields of knowledge that they have learnt in this and other courses.

#### **Reading List**

#### **Compulsory Readings**

	Title
1	Biomechanics: Concepts and Computation (Cambridge Texts in Biomedical Engineering), Cees Oomens, Marcel
	Brekelmans and Frank Baaijens, Cambridge University Press, 2009

# Additional Readings

	Title
1	Biomechanics: Mechanical Properties of Living Tissues, Y.C. Fung, Springer, 1993 (Second Edition)
2	Fundamentals of Biomechanics, Duane Knudson, Springer, 2007 (Second Edition)
3	Introductory Biomechanics: from Cells to Organisms, C. Ross Ethier and Craig A. Simmons, Cambridge University Press, 2007
4	Biomechanics: Circulation, Y.C. Fung, Springer, 2010
5	Biomechanics: Principles and Applications, D.R. Peterson and J.D. Bronzino, Editors, CRC Press, 2008
6	Biomaterials Science: An Introduction to Materials in Medicine, B.D. Ratner, A.S. Hoffman, F.J. Schoen and J.E. Lemons, Editors, Academic Press, 2004 (Second Edition)
7	Biomechanics in the Muskuloskeletal System, M. Panjabi & A.A. White II, Philadelphia, PA, 2001
8	Basic Orthopedic Biomechanics, V.C. Mow and W.C. Hayes, Lippincott-Willimas & Wilkins Press, 1997
9	An Introduction to Tissue-Biomaterials Interactions, K.C. Dee, D.A. Puleo and R. Bizios, Wiley-Liss, John Wiley & Sons, 2002